2019

2ème Conférence
Intensification Durable

Session 1.2

Agroforestry

Vertebrates contribute to natural control of the millet head miner in tree-crop agroforestry systems

8—10 october 2019
Hotel Ngor Diarama
Dakar, Sénégal

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Presentation plan

- Biodiversity services in agroecosystems
- Tree-crop agroforestry systems promote natural pest control
- On the role of birds and bats as insect predators
- Take-home message

Crop pests

A major obstacle to the increase of agricultural production

What about natural pest control?

Intensification of agriculture

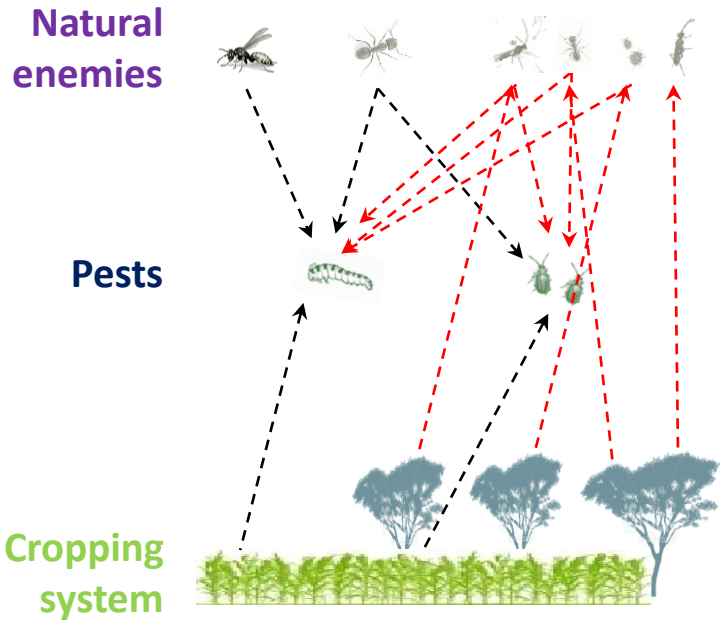
Simplification of agricultural landscapes

Loss of biodiversity and associated ecosystem services such as natural pest control

Cultivated ecosystems more susceptible to pests

Trees can promote natural pest control

By providing habitats to natural enemies in agroecosystems



- Refuges
- Food resources
- Alternative preys
- Microclimate
- Barrier to pest colonization
- Etc.

However, trees can also benefit pests...

What did meta-analyses say?

Agroforestry practices generally result in…

Natural enemies 

Pests 

(Ogol et al. 1999)

↑

↓ in perennial crops (coffee, cocoa and plantain)

→ in annual crops (e.g. maize, rice and beans)

(Pumariño et al. 2015)

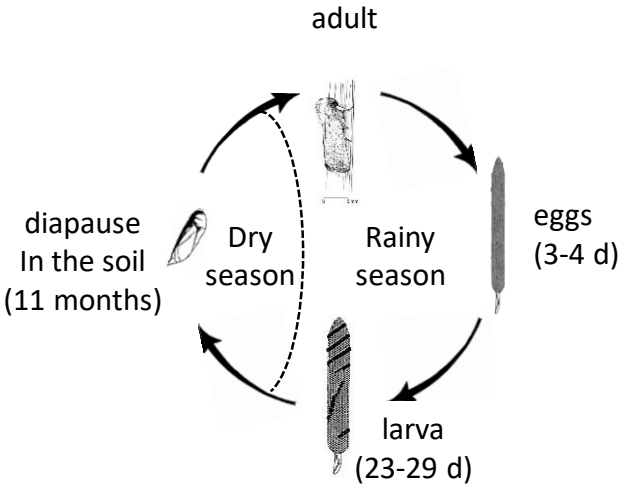
Tree-crop systems as a case study

Traditional agroforestry parkland systems in Senegal

Pearl millet as a staple crop

Wanted: The millet head miner

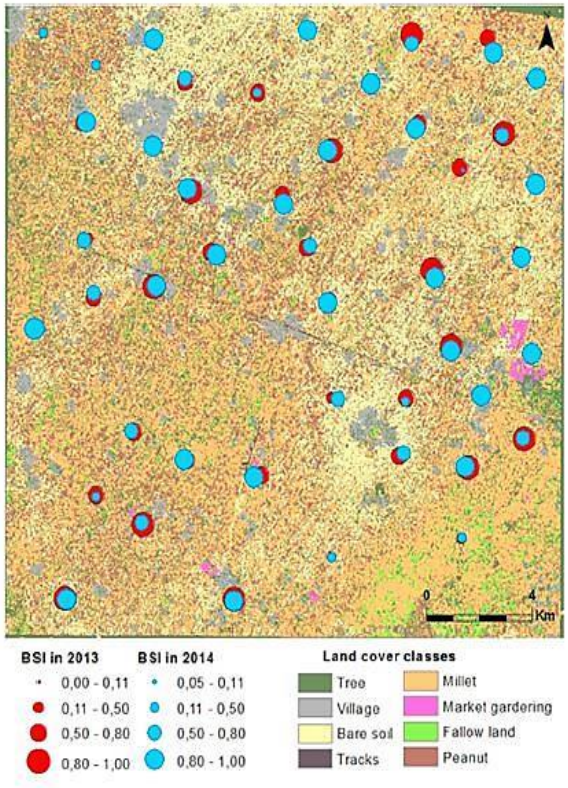
Heliocheilus albipunctella (Lepidoptera, Noctuidae)

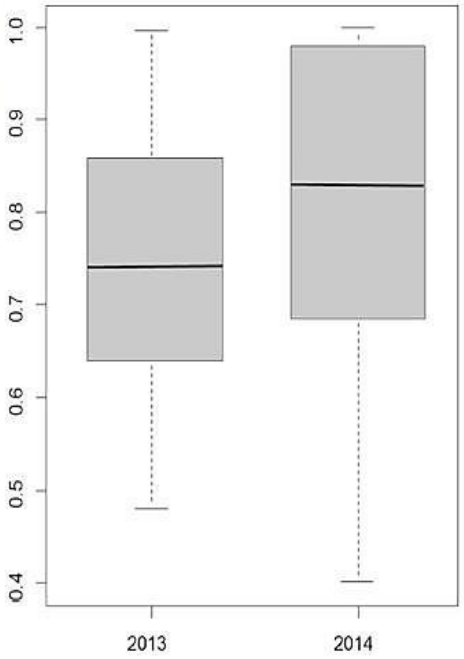


- Monophagous, only one generation a year
- 30-95% infested panicles - 2-20% grain yield loss (Sow et al. 2017)

Tree-crop agroforestry systems promote natural pest control in millet fields

- Natural pest control increases with the abundance of trees in the landscape

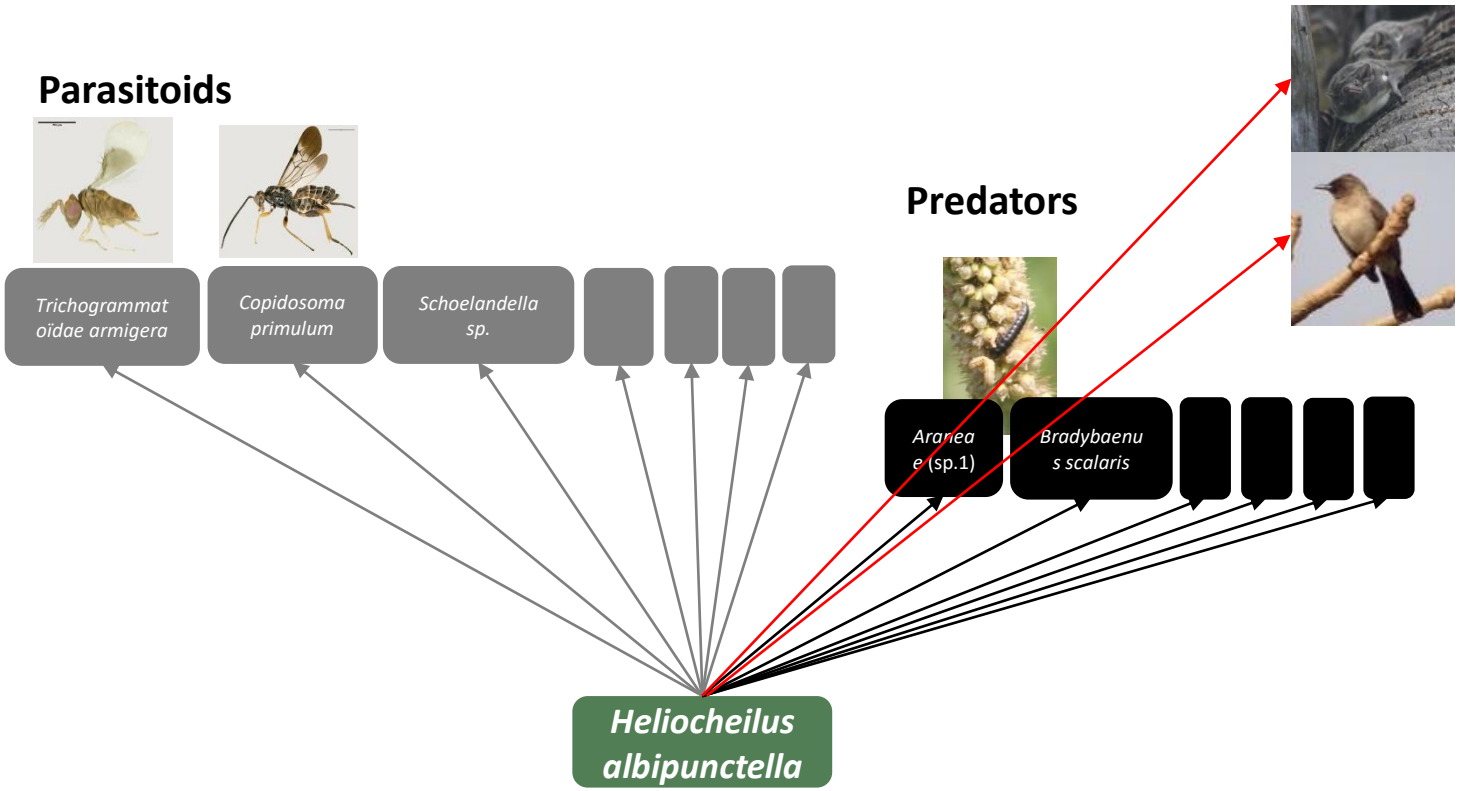




(Soti et al. 2019)

Food webs and natural pest control

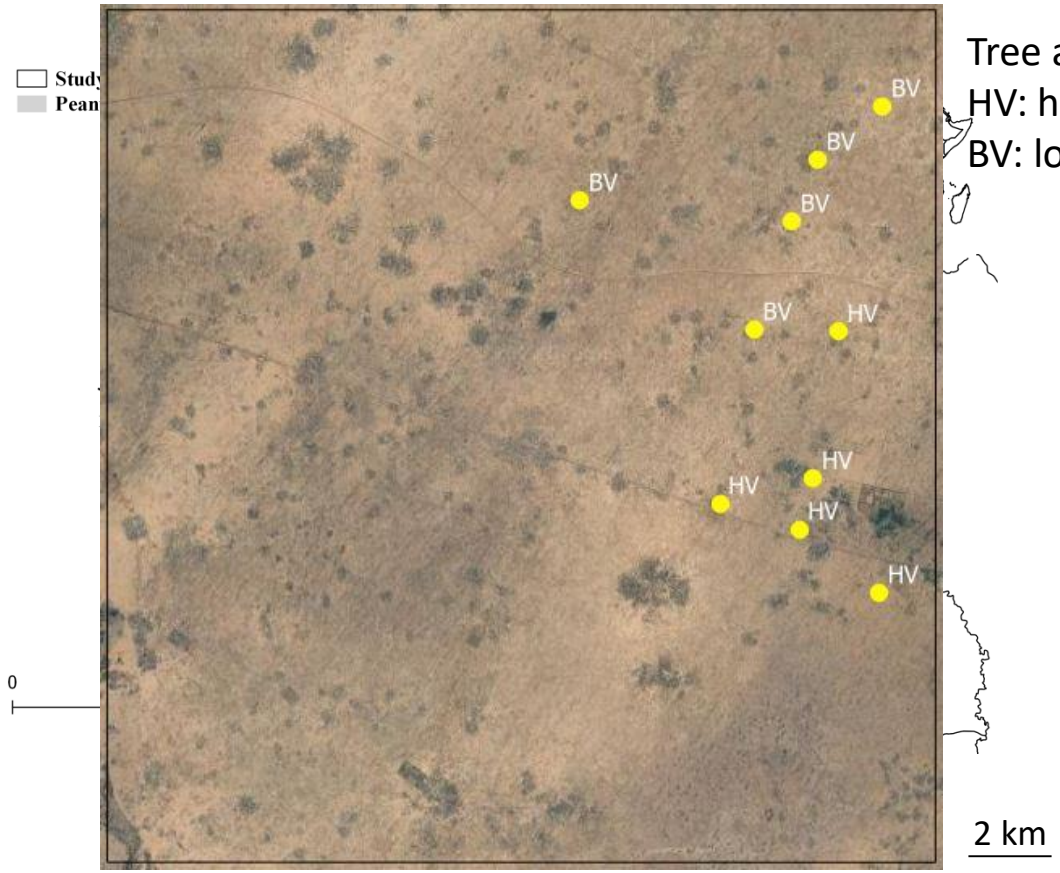
- High throughput molecular tools (metabarcoding) were used to document food web structures (parasitism and predation)



- What about vertebrates?

(Sow et al. 2018, 2019)

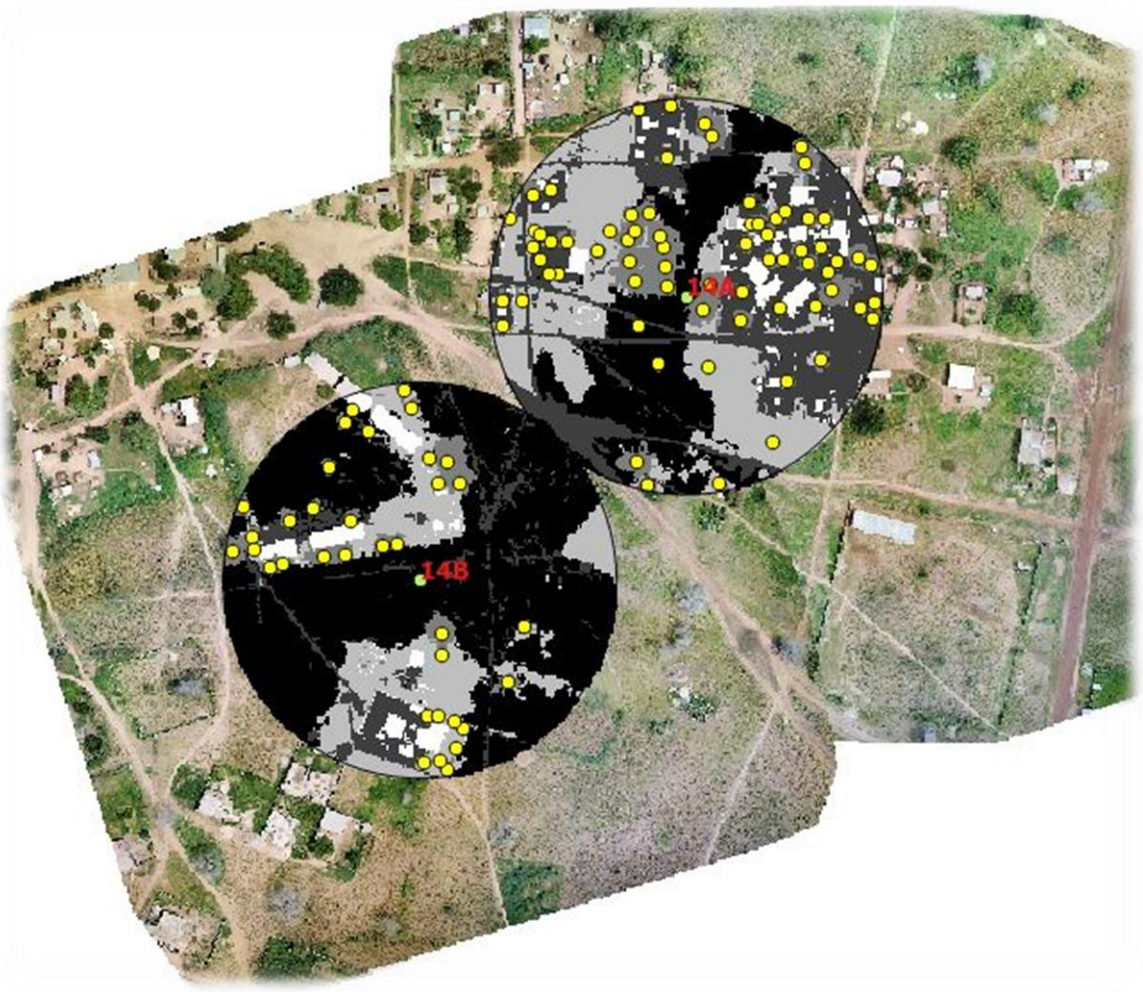
Case study:
Trees, vertebrates and natural pest control



Tree abundance (1000m buffer)
HV: high
BV: low

10 Sites : high vs low tree density in a 1000 m-buffer (landscape)
2 fields per site : open vs closed in a 100 m-buffer (local)

Case study:
Trees, vertebrates and natural pest control

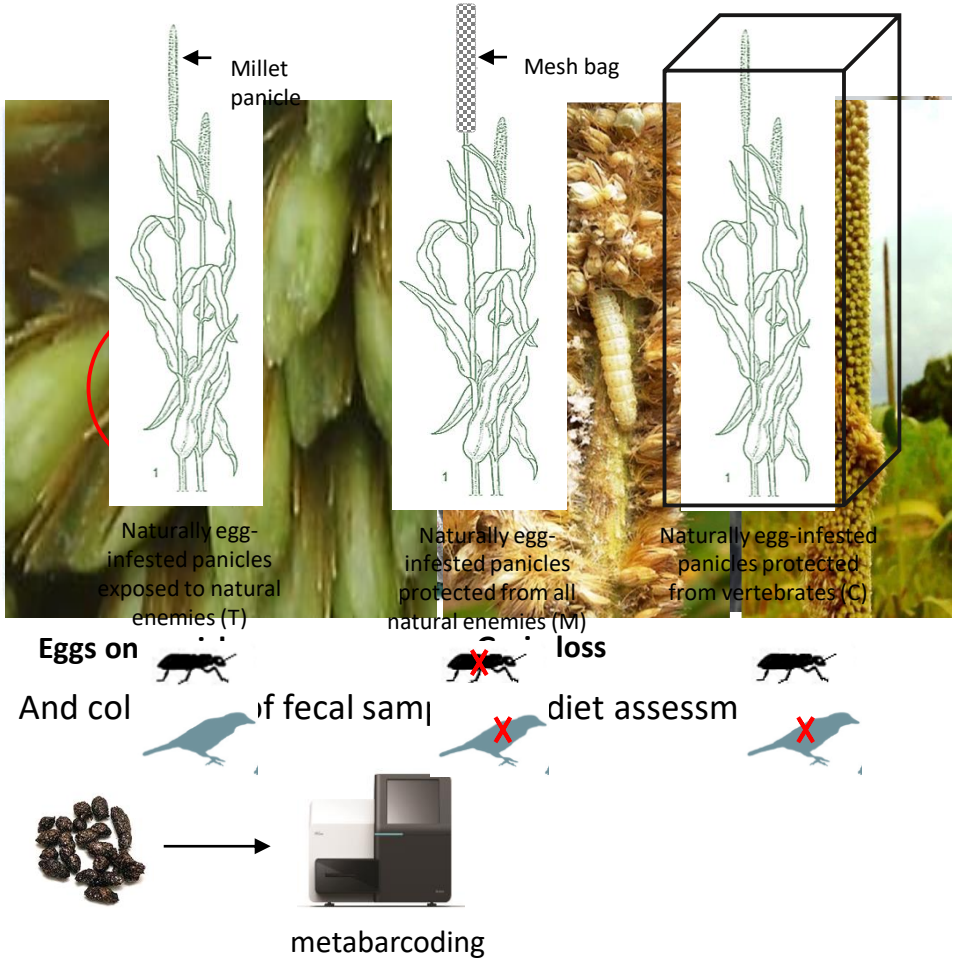


In each site, trees were geolocalised and identified at the species level using drone imagery and remote sensing.

Material and methods

1- Exclusion of natural enemies

2- Field monitoring of birds



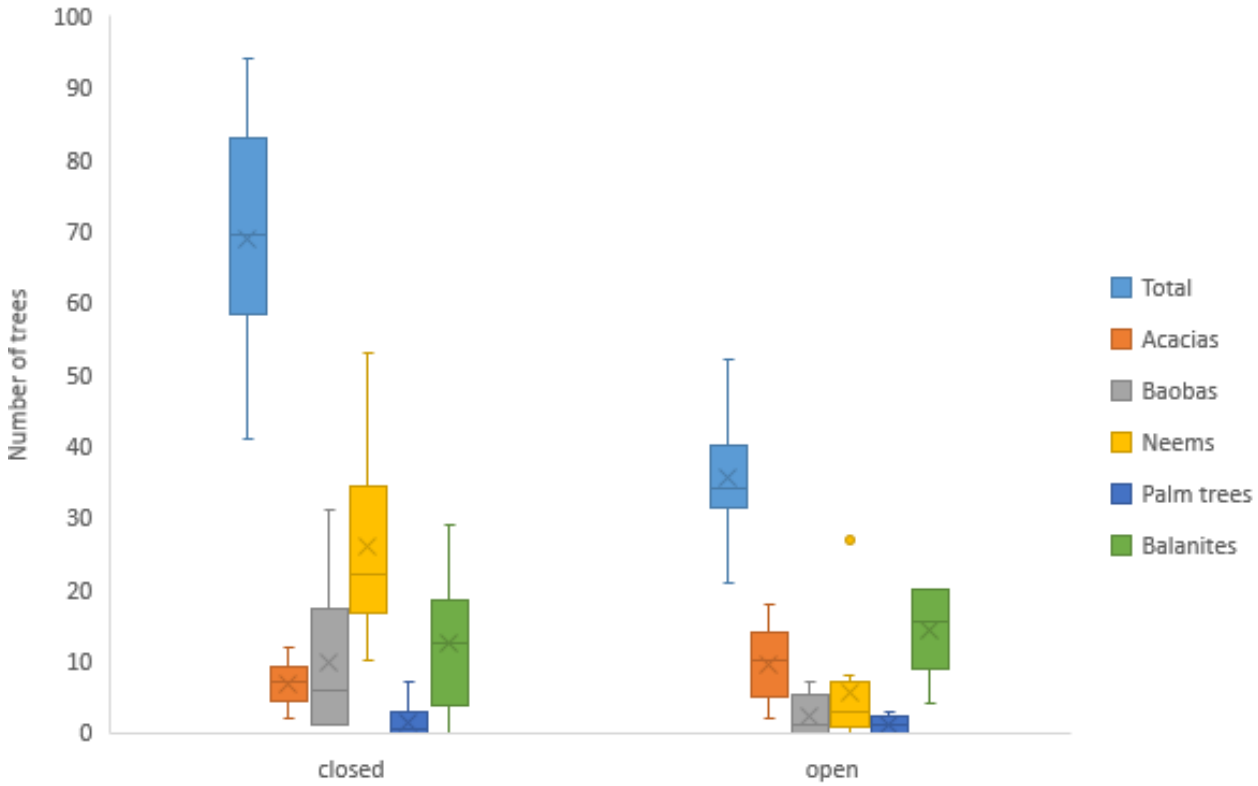
Test of research hypothesis

- Abundance and diversity
- at a local and landscape scale

- Abundance and diversity

- Egg infestation
- Damage

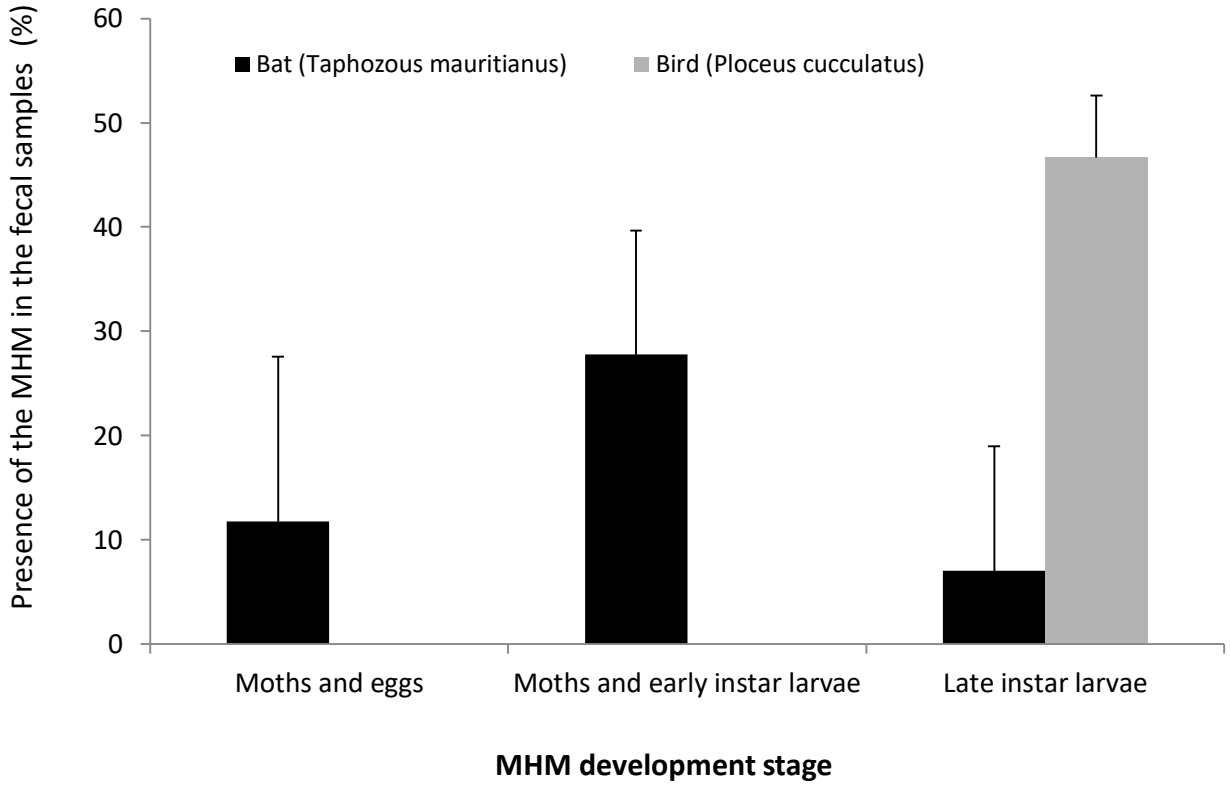
Abundance and diversity of tree cover



Insectivorous birds and bats

Taphozous mauritianus

Detection of pest DNA in feces

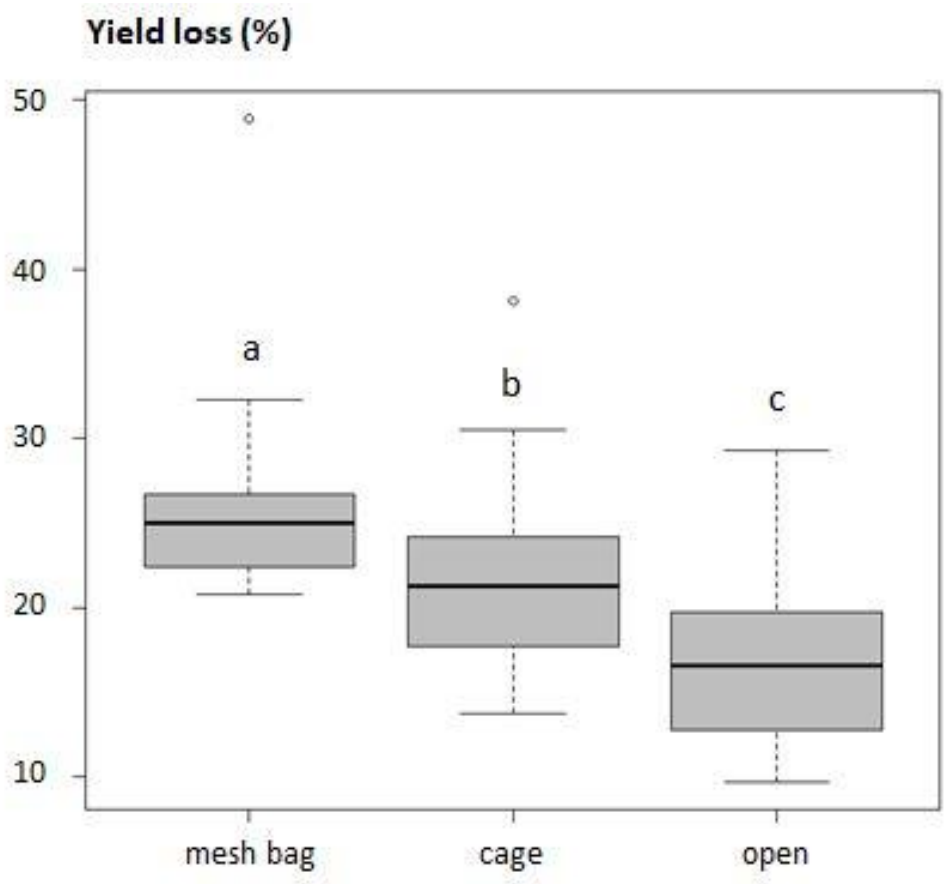


Ploceus cucullatus

Taphozous mauritianus

Predation of the millet head miner was confirmed by molecular analysis of feces or direct observations

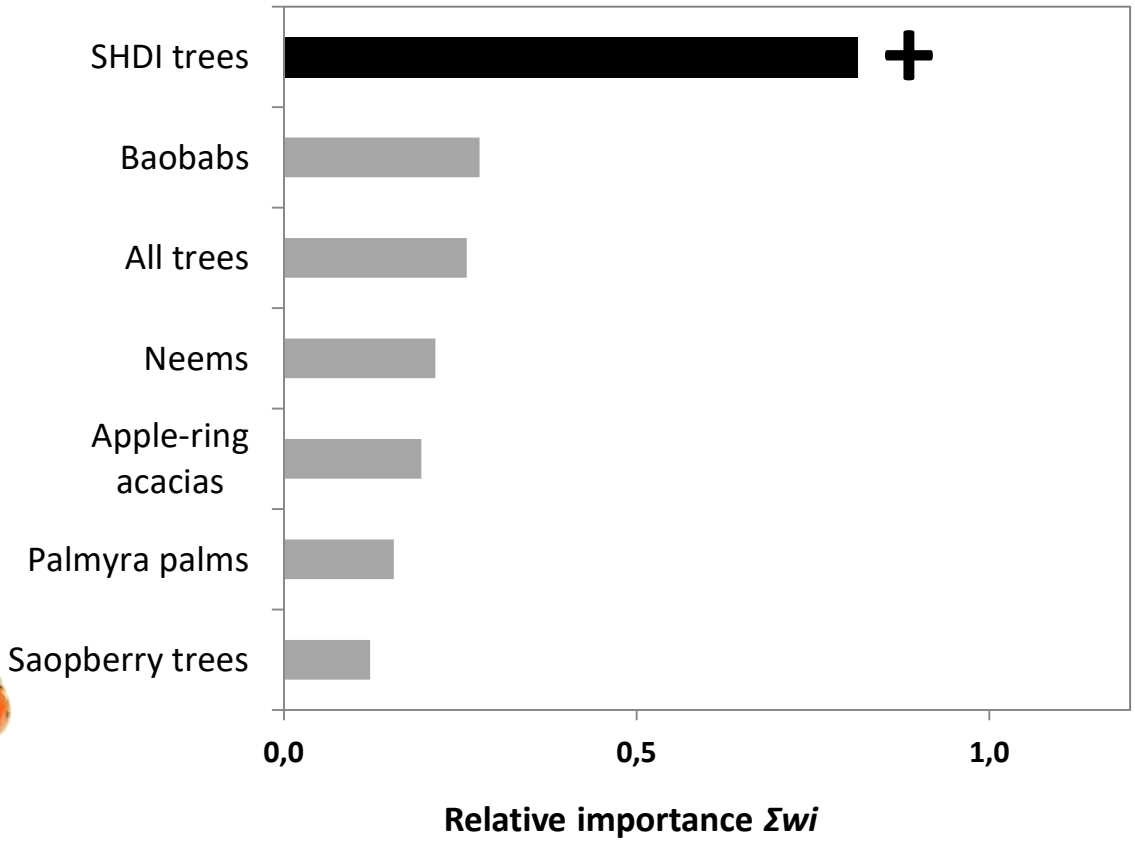
Natural pest control by arthropods and birds



Grain losses were reduced when panicles were accessible to arthropods only, and even more when they were accessible to both arthropods and birds (-35%).

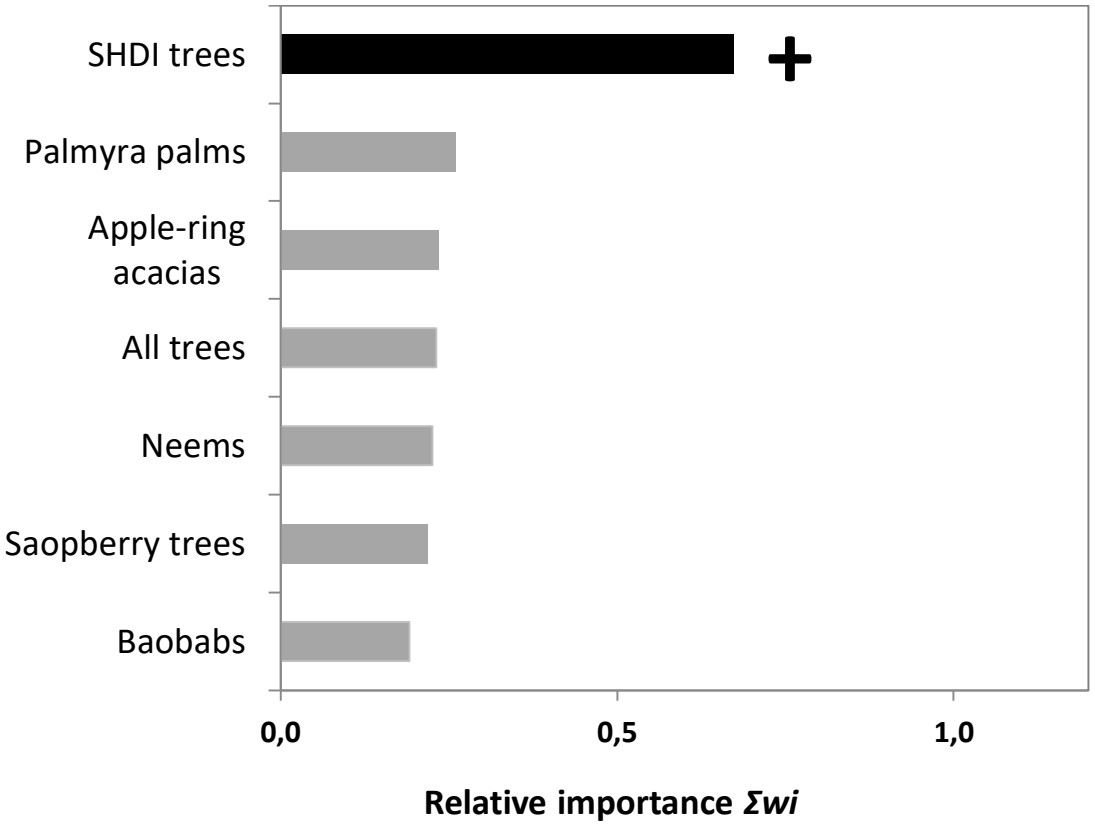
Effect of trees on insectivorous birds

The abundance of insectivorous birds was positively correlated to the diversity of trees at a local scale (SHDI_100 m).



Effect of trees on insectivorous birds

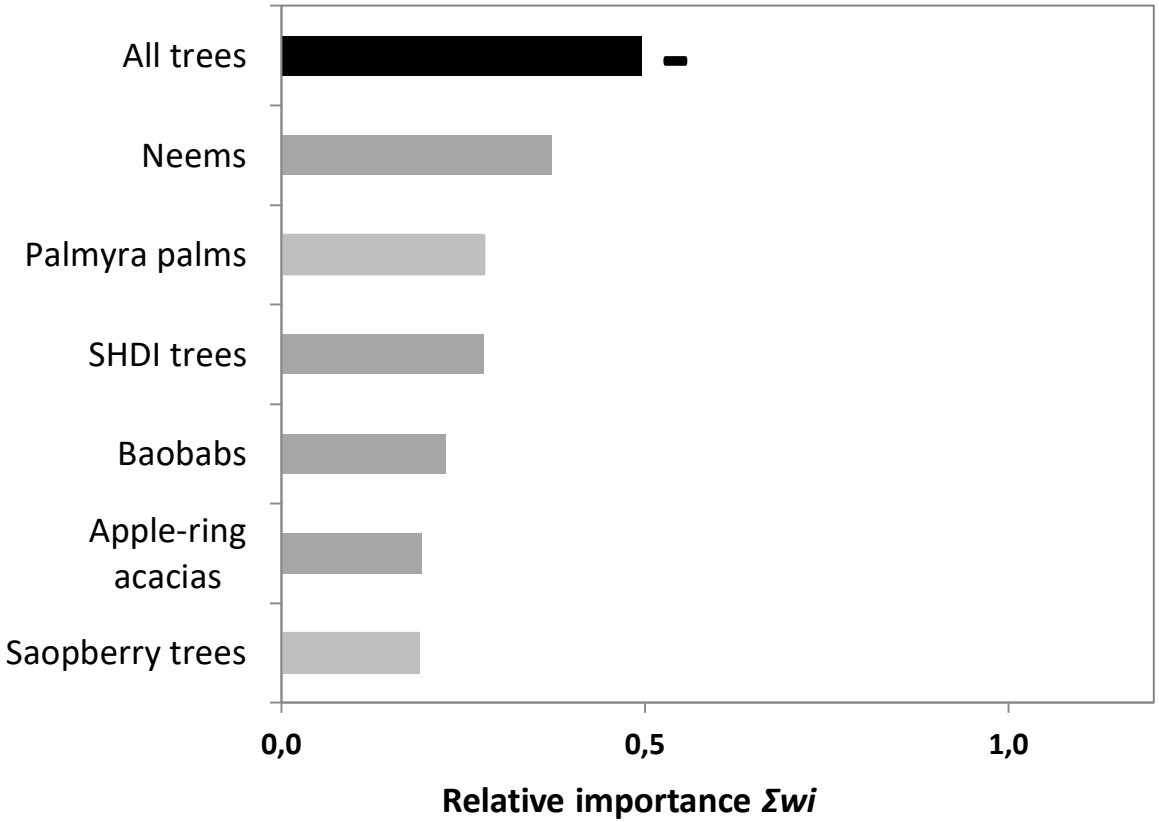
The abundance of village weavers was positively correlated to the diversity of trees



Village weavers

Effect of trees on insectivorous birds

The abundance of the grey-headed sparrow was negatively correlated to the number of trees at a local scale.



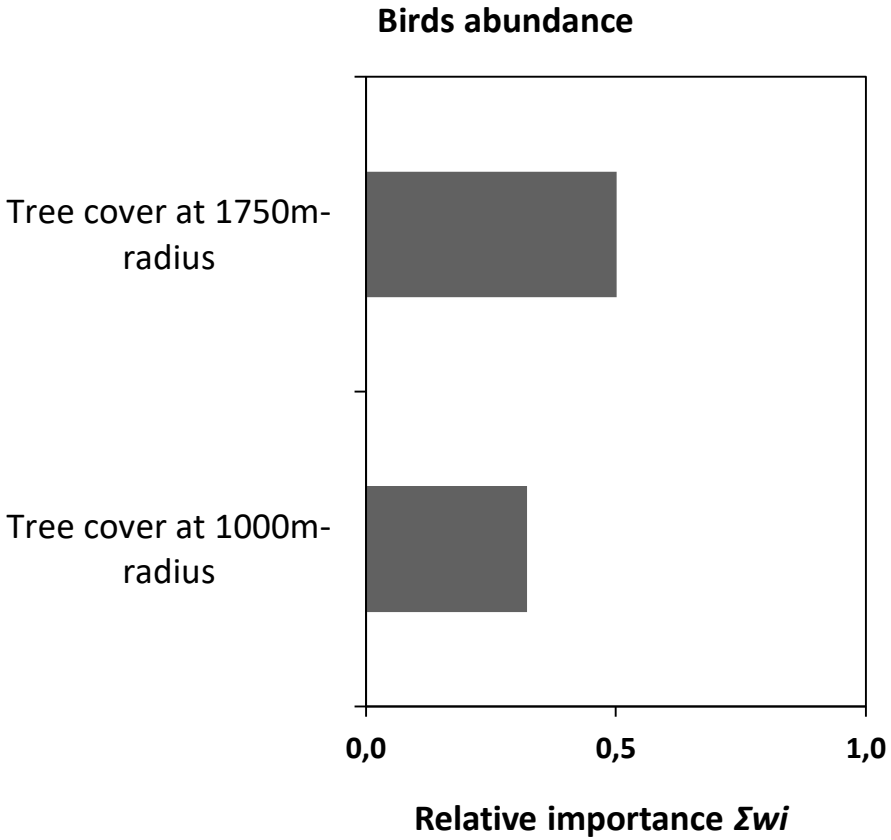
Grey-headed sparrow

Effect of trees on insectivorous bats

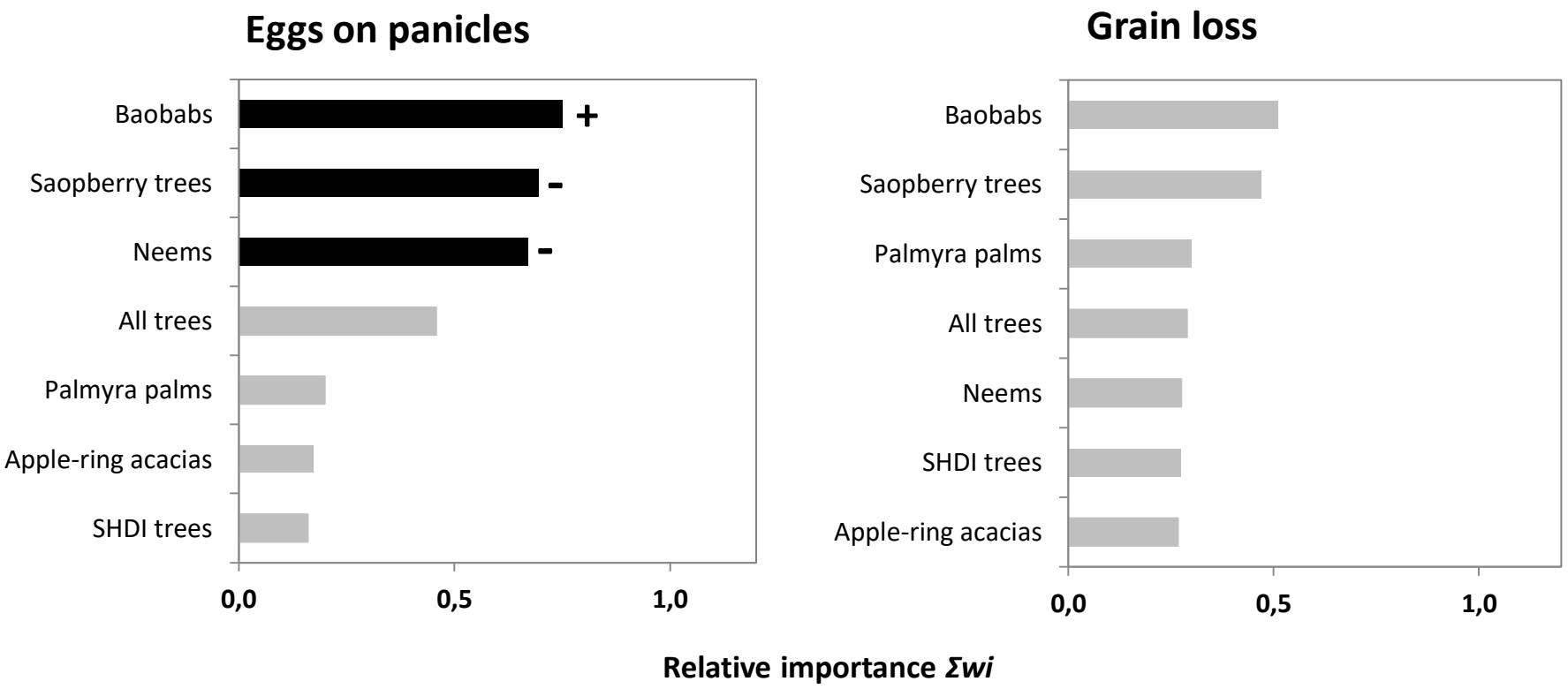
Palm trees (*B. aethiopum*) serve as a specific nesting site for Taphozous bats.

Effect of trees on insectivorous birds

At a lansdcape scale, no effect of trees on the abundance of insectivorous birds.



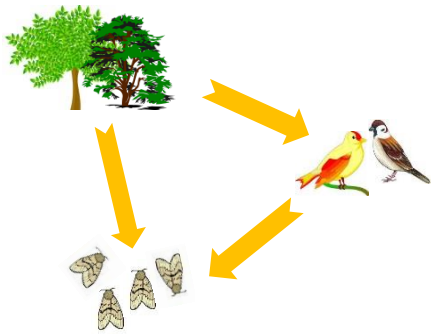
Effect of trees on pest incidence



Positive effect of baobab trees on egg infestation of panicles but negative effect of neems and balanites. No significant relation between trees and grain loss.

Take-home message

- Vertebrates, including birds and bats, are effective predators of the millet head miner.
- They contribute to natural pest control and reduction of millet grain loss.
- The abundance of insectivorous village weaver birds increased with tree diversity whereas that of grey-headed sparrows decreased with the abundance of trees, at a local scale.
- The contribution of trees for natural pest control is species-dependent. Trees can serve as refuges for pest (eg. baobab/moths) and predators (eg. palm tree/bats or neem/village weavers).



Thank you for your attention !

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